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ABSTRACT

Computer networks have provided a foundation for interpersonal computing, and new tools are emerging, the centerpiece of which is called "groupware." Groupware technology is reviewed, and the theoretical framework that will underlie interpersonal collaborative computing is discussed. Groupware can consist of hardware, software, services, and support. It utilizes networking, communications, concurrent processing, and windowing environments. It creates a shared work space for dynamic collaboration in a work group over space and time constraints. The collaboration that it provides also opens many problems that must be addressed in the implementation of groupware in organizations. (Contains 7 references.) (SLD)

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Groupware: A Tool for Interpersonal Computing

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Introduction

Steve Jobs has suggested that the 1980s were the age of personal computing while the 1990s will be the age of interpersonal computing. The advent of interpersonal computing has enormous implications for work and learning. Schrage (1991) reports that "new technologies of collaboration are emerging that will radically transform the way people share their thoughts." Computer networks have provided a foundation for interpersonal computing, but as Schrage mentions, new tools are emerging; the centerpiece is what is called "Groupware." This paper will examine this technology as well as the theoretical framework that will underlie interpersonal, collaborative computing. First, an examination of Groupware.

Groupware

What is "Groupware"? Fraase (1991) defines groupware "as a group of technologies, techniques, and services designed to help people collaborate more effectively, productively, and creatively. Groupware can consist of hardware, software, services, and support." Groupware is based upon the convergence of networking and multimedia technologies. This collaborative computing utilizes networking, communications, concurrent processing, and windowing environments. Hypermedia can also be integrated. Specific media such as voice and video can play major roles in collaborative computing, although the limited ability of computers to recognize or manipulate their content complicates their full integration.

Beyond technical definitions, groupware is about groups of people managing their collective information resources (Fraase, 1991). The collaborative context appears wherever people are working together to add value. Groupware is intended to create a shared workspace that supports dynamic collaboration in a work group over space and time constraints. Supporting team collaboration over time is the central purpose of most groupware. However, groupware can support many activities. Johansen (1988) identifies seventeen functions that groupware can support:

- Face-to-face meeting facilitation
- Group decision support
- Computer-based telephony extensions
- Presentation support

- Project management
- Calendar management
- Group-authoring
- Computer-supported face-to-face meetings
- Screen-sharing
- Computer conferencing
- Text filtering
- Computer-supported audio/video teleconferencing
- Conversational structuring
- Group memory management
- Spontaneous interaction
- Comprehensive workgroup support
- Nonhuman meeting participants (using intelligent agents)

Different groupware systems emphasize different capabilities. Systems that are commercially available tend to emphasize computer networking capabilities. Some groupware packages enhance e-mail with features that help route "compound" documents among coworkers collaborating on a document. At a higher level, groupware is much more than enhanced e-mail --- it's a multiuser database that can be used for group projects. More advanced collaborative groupware packages permit the creation of compound documents made up of several types of media. Group-created documents that are often limited to text and graphics will increasingly take on other data types, such as sound, still video, animation, and movies (Fraase, 1991). Experimental groupware systems under study in research labs in Japan, europe, and the United States exemplify these more sophisticated capabilities. For example, the Xerox PARC Media Space emphasizes videoconferencing, including a computer-based VideoWhiteboard that serves as a drawing tool. This VideoWhiteboard is described as "a high tech version of shadow puppet theater (Brittain, 1991)." It is an electronic screen that can be used for writing notes and drawing diagrams, just like a traditional whiteboard (or blackboard). This VideoWhiteboard can be seen --- and written upon --- by coworkers at different sites simultaneously. For a detailed description of groupware systems, refer to McLellan & Knupfer (In press).

Collaboration

Groupware technology provides a platform to support collaboration and other forms of interpersonal computing. In order to support collaboration via technology, it is essential to understand what constitutes collaboration. Collaboration is not merely communication. Schrage (1991) defines collaboration as "the process of *shared creation*: two or more

individuals with complementary skills interacting to create a shared understanding that none had previously possessed or could have come to on their own. Collaboration creates a shared meaning about a process, a product, or an event. In this sense, there is nothing routine about it. Something is there that wasn't there before. Collaboration can occur by mail, over the phone lines, and in person. But the true medium of collaboration is other people. Real innovation comes from this social matrix."

According to Schrage, "Quality collaboration --- the kind of efforts that have driven breakthroughs in science, the arts, and technology --- occurs with neither the frequency nor the intensity it should, in part because there are few tools explicitly designed to encourage or support it." Groupware offers the potential to support collaboration, but in designing and implementing groupware, it's essential to understand both the technology and the nature of collaboration. Norman (1991) points out that the same principles that apply to the development of computer systems for individuals are not sufficient for computer systems for groups. It is not these design principles do not apply. Rather, group activity is vastly different from individual activity and has its own needs and requirements. "Technology alone cannot provide the answers when we deal with human activities. The tasks, the culture, the social structure, and the individual human are all essential components of the job, and unless the computational tools fit "seamlessly" within this structure, the results will be failure (Norman, 1991)."

So just what is collaboration? Los Angeles Times reporter Michael Schrage (1991) has written an insightful book, Shared minds: The new technologies of collaboration, that explores this issue in depth: "Collaboration describes a process of value creation that our traditional structures of communication and teamwork can't achieve." The driving spirit behind any collaboration is always dynamic; it should never stagnate. Schrage identifies two types of collaboration: formal and informal collaboration. Formal collaboration is the process we follow in highly-structured settings such as meetings and task forces. This type of collaboration revolves around structures, procedures, and formal processes. Informal collaboration is characterized by less-formal settings and less structured, more

casual interactions, for example, crossing paths in hallways, at the coffee machine, over lunch. Informal collaborations are much less structured than a formal collaboration. Good collaborators, regardless of the type of collaboration employed, "accept and respect the fact that other perspectives can add value to their own (Schrage, 1991)." Schrage suggests that we collaborate not only with our co-collaborators but with the symbols people create.

Schrage identifies collaboration goals or outcomes and collaboration constraints. Collaboration may result in (1) Problem solving; (2) Creativity; and/or (3) Discovery. Collaboration constraints include: (1) expertise; (2) time; (3) money; (4) competition; and (5) conventional wisdom and common sense.

According to Schage, there are thirteen design themes that characterize collaboration, including: (1) Competence; (2) A shared, understood goal; (3) Mutual respect, tolerance, and trust; (4) Creation and manipulation of shared spaces; (5) Multiple forms of representation; (6) Playing with the representations; (7) Continuous but not continual communication; (8) Formal and informal environments; (9) Clear lines of responsibility but no restrictive boundaries; (10) Decisions do not have to be made by consensus; (11) Physical presence is not necessary; (12) Selective use of outsiders for complementary insights and information; and (13) Collaboration's end.

Groupware offers the potential to support all of these design themes. Design theme Four --- Creation and manipulation of shared spaces --- is especially relevant to a groupware collaboration context. According to Schrage: "All collaborations rely on a shared space. It may be a blackboard, a napkin, a piano keyboard, a rehearsal room, a prototype, or a model. Independent of whether the collaborators are artists, scientists, professionals, managers, or mechanics, collaborators are inevitably drawn to a shared space to share the ideas and insights that will solve the problem or achieve the task. The shared space becomes a partner in collaboration." Groupware readily offers multiple forms of representation and this capability will increase as the technology advances. Related to this, groupware offers collaborators the capability of playing with the representations. Continuous but not continual communication is made highly convenient in a groupware

environment. Some other factors that underlie collaboration include the following: (1) Conflicts are not two-sided; (2) All problems are interdisciplinary; (3) Solutions can be reached by widening the community; (4) Consensus doesn't have to mean unanimous agreement; (5) Voting doesn't work; consensus building does; and (6) Sometimes it's best to just agree rather than trying to agree on why you're agreeing (Schrage, 1991).

The collaborative process can be broken down into two distinct elements: conceptual collaboration, and technical collaboration (Schrage, 1991). Conceptual collaboration is the process of defining the overall goal of the collaboration. This must precede the technical collaboration. An example of conceptual collaboration, according to Schrage, is when a film director and a cinematographer block the action and camera angles before filming begins. Technical collaboration is the actual attempt to solve the problem that was defined in the conceptual collaboration. This is apt to be a process of repeated attempts. A good example of technical collaboration is James Watson and Francis Crick working on the DNA model to establish the structure of DNA (the double helix), based on their conceptual model.

Interpersonal computing is qualitatively different from personal computing. Norman (1991) emphasizes that this qualitative difference should inform the design of interpersonal computing tools. Other analysts speculate about the social impacts of interpersonal computing. For example, Perin (191) explains that electronic social fields --- interpersonal computing --- may threaten managers' assumptions about conventional bureaucratic organizations because they call into question organizational authority, they cross functional divisions, and they create options for the times and places of work. So that while the virtual groups linked by groupware may enhance innovation and productivity in bureaucracies, interpersonal computing may be susceptible to managerial suspicion and negativism. This is an issue that will have to be addressed in the implementation of groupware systems within organizations.

According to Schrage, it is essential for individuals and institutions to make the adjustment to interpersonal, collaborative computing: "As individuals, we each possess

special skills and expertise, plus the desire to apply them productively. Yet to a disturbingly large degree, most organizations lack the collaborative infrastructures that enable people to share their talents in ways that satisfy the individual's need for expression and the organization's imperative for results. As a result, people feel increasingly frustrated, and the organizations that employ them moan about declining productivity and shriveled morale. There's no balance." Groupware tools offer the potential to redress the balance so that collaboration can flourish.

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